I-77 Feasibility Study (I-85 to Griffith Street)

TIP Project No. FS-0810B

Task Order No. 3 – Use of Shoulders for Travel Lanes

Sub-task 3.D, Identification and Development of I-77 Shoulder Use Issues

TECHNICAL MEMORANDUM

(FINAL)

November 2009

1.0 INTRODUCTION

Task Order No. 3 analyzes the advisability and feasibility of converting I-77 shoulders to travel lanes, either on a part-time or full-time basis, as an interim traffic management measure. The study area includes the I-77 segment between the I-85 interchange and Griffith Street (SR 2158) in Davidson. Issues related to safety, liability, and operational thresholds are important to the North Carolina Department of Transportation (NCDOT) as the department considers this possible approach of getting more out of facilities which are already in place.

Under sub-task 3.A of this task order, Texas Transportation Institute (TTI) prepared a technical memorandum to highlight the existing body of knowledge regarding the implementation of using shoulders for general traffic operations through a literature search and personal interviews with staff members from other jurisdictions. Information from TTI's inventory and assessment was used to develop potential resolutions, as discussed in the next section, to issues associated with the use of shoulders for general purpose traffic.

2.0 POTENTIAL RESOLUTION OF IDENTIFIED ISSUES AND CONSIDERATIONS

Possible solutions to operating issues related to general purpose traffic using I-77 shoulders are discussed by category in the following sub-sections, based on experiences in implementing similar projects in other urban areas.

2.1 TERMINI

Issue:

What are appropriate and optional termini for inbound and outbound shoulder operations? What design (i.e., right side ramps) and operational issues (i.e., weave or merge volumes) should most drive this determination?

Recommended Resolution:

Based on the 2013 traffic volumes and CORSIM analysis, the appropriate limits of shoulder use lanes are:

- Northbound: from Gilead Road (lane would continue north instead of dropping at Gilead Road north of I-485 through Exit 28 (end as exit-only lane)
- Southbound: from the Exit 28 on-ramp though the addition of lanes north of the I-485 interchange

Determination of these limits was based on the high entry and exit volumes at Exit 28. With this improvement, the segments north of Exit 28 would operate at acceptable conditions.

Issue:

NCDOT Division 10 identified shoulder operations as a strategy to address southbound congestion in AM peak hours between I-485 and Exit 28 (or possibly north to Exit 30). The travel demand need seems to be more line-haul than bottleneck relief for a short roadway segment. What specific safety and operational needs are appropriate to consider for a line-haul condition?

Recommended Resolution:

The traffic benefits would only be realized by line-haul operations and not as auxiliary lanes between interchanges.

Further study of signing and marking requirements will be needed to identify and mitigate potential safety issues, especially in the southbound direction due to 1) the two entry points for Exit 28 and 2) the transition into the mainline and ramps lanes at I-485.

2.2 DESIGN

Issue:

What should be the minimum and desirable width of the shoulder travel lane? MnDOT in Minneapolis used 11 feet when they converted the shoulder along a portion of I-94 to travel lanes after the collapse of the I-35W bridge. Temporary use of shoulders along I-66 for travel lanes in Virginia requires 12 feet of pavement; however, VDOT has retained a small amount of pavement (1 foot to 12 feet) in some locations along I-66 to help with wider vehicles.

Recommended Resolution*:*

The minimum width of the shoulder travel lane would be 11 feet while the desirable width is 12 feet.

Issue:

What buffer to the right side rail is needed?

Recommended Resolution:

The minimum buffer to the guardrail would be a minimum of two feet along with proper attenuation for exposed rail placed this close to a travel lane.

Issue:

What pavement characteristics are needed to support the intended traffic? Are trucks to be considered as part of the intended traffic to use shoulders?

Recommended Resolution:

Pending an NCDOT analysis of adequacy, the existing shoulder pavement structure of 3.5 to 5.5 inches of asphalt on 1 inch of BST and 12 inches of CT ABC would have to be strengthened to accommodate auto traffic. Trucks (defined as three or more axles) should be restricted from shoulder use.

Issue:

What pavement surface treatment changes may be necessary in conjunction with widening (i.e., roto-milling and overlaying pavement and restriping) if typical section changes? Will rumble strips be removed when the shoulder is converted?

Recommended Resolution:

As discussed previously, overlaying of the existing shoulders would be required in those areas where general purpose traffic is permitted. The existing rumble strips either would be removed, or moved and re-installed on the pavement markings.

Issue:

What, if any, additional illumination is needed?

Recommended Resolution:

In addition to standard illumination at ramps, illumination is recommended at the termini of the shoulders where general purpose traffic is allowed.

Issue:

What signing and pavement marking changes? What types of traffic control devices, if any, are needed? How will these changes look for either approach to shoulder use?

Recommended Resolution:

For temporary shoulder use, overhead regulatory signs in combination with lane control signals would be installed. These overhead signs and traffic controls would be similar to VDOT's installations along I-66 and would be supplemented by ground-mounted regulatory signs providing 1) hours of operation, 2) locations of emergency pull-offs, and 3) beginning and ending locations of part-time shoulder operations. The pavement markings would be no different than normal travel lane to shoulder edge line marking.

For full-time shoulder use, ground-mounted regulatory signs would be added to notify motorists of 1) the prohibition of stopping on the shoulder, 2) locations of emergency pull-offs, and 3) beginning and ending locations of shoulder operations. The pavement markings would be a single white skip line just like the rest of the general purpose lane markings.

Issue:

Are there needs for traffic detection in pavement, cameras, or other Intelligent Transportation System (ITS) considerations?

Recommended Resolution:

Any gaps in closed circuit television (CCTV) coverage, particularly under bridges, would be addressed in those areas where shoulder operations are being considered.

Issue:

How will shoulder operations be treated for ramps at interchanges?

Recommended Resolution:

Vehicles traveling in the shoulder along I-77 would travel across entrance and exit ramps just as they would if they were in general purpose travel lanes.

Issue:

How will fixed objects in the recovery area of the shoulders be treated?

Recommended Resolution:

If shoulder operations are found to be an effective strategy to reduce congestion, fixed objects will need to be identified and addressed through adding barriers or changing the lengths of acceleration or deceleration lanes. These strategies were used along I-94 in Minneapolis and I-66 in Virginia.

Issue:

Will changes in drainage inlets be necessary?

Recommended Resolution:

If shoulder operations are found to be an effective strategy to reduce congestion, design exceptions may be required to handle the cross-slopes across the facility. The need for additional drainage inlets also could be explored to handle cross-slope issues.

Issue:

What design changes are necessary to provide for vehicles which must stop because of an emergency? Would emergency pull-outs be required? If so, what design and interval?

Recommended Resolution:

Emergency pull-outs help to improve safety and reduce travel disruption when shoulders are used to move general purpose traffic. The frequency of I-77 pull-outs depends on the length where shoulder operations are permitted and possible locations where it is safe to get off the shoulder. I-66 in Virginia includes both formal and "informal" pull-outs with the latter being locations where traffic can get off the shoulder and into a safe area. The entrance and exit tapers to the formal I-66 emergency refuge areas are 300 feet.

2.3 OPERATIONS

Issue:

Should traffic be permitted to use the shoulder part-time or full-time? Under what conditions or restrictions?

Recommended Resolution:

The traffic benefits are primarily realized during peak periods; however, full-time use of the shoulder use lane would remove any driver uncertainty of lane exits and alignments. Truck restrictions for the shoulder lanes may present problems because trucks are accustomed to using the right lanes and many will want to use the right-side ramps at I-485.

If the shoulder pavement would support (or could be strengthened to support) traffic, and NCDOT accepts minimal shoulders, then full-time traffic could be considered. An alternative solution may be a separate project to add a new single general purpose lane (with shoulder) in each direction between I-485/Exit 23 and Exit 28, similar to the project which added a northbound lane between I-485 and Exit 23.

Issue:

What are the impacts on emergency response agencies when accidents occur and there is no outside shoulder to use in reaching or leaving the accident scene? How are disabled vehicles (minor incidents) on the shoulder handled in order to avoid disruption? How are major incidents handled?

Recommended Resolution:

The Mecklenburg County Incident Management Team should be consulted in developing procedures for handling different types of traffic incidents along I-77 where shoulders are used by general purpose traffic. Strategies similar to those implemented by the Florida Department of Transportation (FDOT) to maintain safety along I-95 when the inside shoulder of this freeway was converted to a managed lane include:

- Expanded CCTV coverage with dedicated MRTMC staffing to monitor traffic activity along the I-77 sections where shoulders are used and to facilitate quick response to incidents
- Increased State Highway Patrols (SHP) when shoulders are used by general purpose traffic

- Dedicated Incident Management Assistance Program (IMAP) vehicles to clear breakdowns rapidly
- Information provided to motorists using signage, internet, and other marketing approaches on what to do in the event of an incident. This could include special telephone numbers to notify SHP and IMAP.

Issue:

Is special legislation required to implement traffic operations on shoulders? What is the State's liability in allowing traffic to operate on a designated shoulder part-time? What is the State's liability if the shoulder is permanently striped as a travel lane?

Recommended Resolution:

Section 20-146.2 (b) of North Carolina General Statutes addresses *Temporary Peak Traffic Shoulder Lanes*:

> "The Department of Transportation may modify, upgrade, and designate shoulders of controlled access facilities and partially controlled access facilities as temporary travel lanes during peak traffic periods. When these shoulders have been appropriately marked, it shall be unlawful to use these shoulders for stopping or emergency parking. Emergency parking areas shall be designated at other appropriate areas, off these shoulders, when available."

Issue:

What are the impacts on maintenance activities of shoulder use? Will there be increased damage to signs, barriers, etc. because of closer proximity to moving traffic? Will there be a need for lane closures to conduct ongoing freeway maintenance?

Recommended Resolution:

Damage to traffic control and safety devices located adjacent to the shoulder would be monitored for increased occurrences. NCDOT procedures used for median maintenance could be adapted for shoulder operations. Part-time traffic operations along shoulders would present less of a problem in conducting ongoing freeway maintenance.

Issue:

How will illegal use of shoulders be enforced if part-time operations are implemented?

Recommended Resolution:

As discussed previously, Section 20-146.2 (b) makes it unlawful to use shoulders for stopping or emergency parking when they are in use for as travel lanes. Conversely, motorists would be prohibited from traveling along the shoulder during those periods when they are intended for emergency purposes. SHP officers would be responsible for monitoring and enforcing I-77 sections where shoulders are in use.

2.4 ENVIRONMENTAL

Issue:

Are there environmental impacts related to shoulder operations? What type of environmental clearances would be required?

Recommended Resolution:

Section 20-146.2 (b) permits NCDOT to modify, upgrade and designate shoulders of controlled access facilities like I-77 as temporary travel lanes during peak traffic periods. The temporary conversion of I-94 shoulders to travel lanes in Minneapolis was performed without any environmental clearances as a traffic control measure. Each project is different, and specific characteristics of any conversion on I-77 would need to be assessed to determine if the treatment is eligible as a Categorical Exclusion, or whether a more in-depth review would be required.